

DORIS DAYS 2000 Symposium

Toulouse, France

May 02 – 03, 2000

Abstracts

SESSION: ORBIT DETERMINATION

Orbit Determination using On-Orbit GPS

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The reliability and accuracy of GPS is subject to the SA influence. On-orbit GPS can not be a only method to determine low-earth orbit (LEO) satellite orbit. On the other hand, using Doppler data to determine precise LEO satellite orbit needs a global network, a very expensive network, and a set of precise dynamic models that include the atmosphere density model which is very difficult to be precisely described. It is the effective way to combine on-orbit GPS and Doppler data in precise orbit determination. It can reduce the SA influence, the number of station in a global network and the requirement of precise dynamic model. This paper focuses on the combination of two types of observations and introduces some experiment results in our space mission.

Improving the TOPEX/Poseidon Orbit Using DORIS Tracking

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The DORIS radial accuracy mission objective for TOPEX/POSEIDON (T/P) has been satisfied with 2-3 cm NASA Precision Orbit Ephemeris (POE) orbits routinely produced. However, with refined measurement modeling it may be possible to take greater advantage of the dense tracking DORIS has to offer to further improve the accuracy of the POE. Tests include using time correlated troposphere estimation, the ITRF97 station coordinates, improved station weighting, and precise timing bias estimates. Subsequent application of the reduced-dynamic approach in GEODYN using current DORIS and SLR tracking may further improve the T/P POE, and will contribute to a better understanding for meeting the 1-cm JASON goal.

Geocenter Motion Determined with DORIS and SLR Data, Comparison with Surface Loading data

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DORIS and SLR data were processed and combined in order to determine the Earth center of mass over the 6-year period from January 1993 to December 1998. The seasonal variations of the DORIS-SLR reference frame origin were computed by determining 3 translation parameters between monthly coordinates of the DORIS and SLR networks. These translation parameters are interpreted as the geocenter motions. These variations that are due to the mass redistribution inside the surface fluid envelopes of the Earth were compared to the variations of the 1 degree geopotential coefficients also computed with the same data. During the 1993-1998 period the geocenter coordinates obtained by space geodetic measurements were then compared to geocenter variation obtained from various geophysical sources, i.e. atmospheric pressure, ocean mass, and surface ground water load.

Contributions of DORIS to Precision Orbit Determination, Station Positioning and Gravity Field Investigations

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The DORIS system yields almost continuous coverage of the TOPEX/POSEIDON orbit and, consequently, provides the principal contribution to the radial orbit accuracy of approximately 2 cm currently being obtained for that

satellite. Even better orbit determination can be expected with the enhanced receiver on the Jason-1 altimeter satellite. With over seven years of continuous, high quality tracking of T/P, the accurate determination of the position and motion of the DORIS tracking stations can be achieved. The DORIS system also delivers global coverage of the SPOT-2 and SPOT-3 satellites, providing an important complement to the SLR data for measuring the temporal variations of the gravity field, particular the non-zonal terms. These applications indicate that the DORIS system is a mature and valuable complement to the various geodetic measurement systems, which will continue to be important in the future.

DORIS: A Core Orbitography and Positioning System to Realize the Full Potential of Altimetry

Patrick Vincent, CNES, *France*

The DORIS system was developed by CNES, IGN and GRGS to meet science and operational user requirements in very precise orbit determination and high accuracy location of ground beacons for point positioning. The goal of the paper is to demonstrate that DORIS helped opening a new era in altimetry since TOPEX/POSEIDON (T/P), and that DORIS will insure that long time series of altimeter measurements may be used in a consistent manner for the highly accurate quantification of the tiny ocean signals impacting climate change at multi-year time scales.

GEOS3, SEASAT, GEOSAT demonstrated that satellite orbit error has been the bane of oceanographers who analyze altimetry data with quantitative objectives. Nonetheless, to overcome this difficulty, altimeter users imagined various error reduction methods that proved to be very efficient, in particular for ocean mesoscale purpose. However, when focussing on long wavelengths of the ocean spectrum, then, even the most sophisticated orbit error reduction methods are not entirely satisfactory, as they simultaneously remove any type of long wavelength errors and signals. The launch of T/P, whose system definition was optimized for the quantification of large scale ocean signals, inaugurated a new era. Indeed, all elements of the T/P altimetric system were defined to allow a major step towards a very accurate quantification of ocean signals at the large scale. In that system, DORIS had a major role in the frame of high accuracy orbit determination and in the maintenance of a geodetic reference frame. This is true for many reasons: 1. features of the DORIS system itself: accuracy of the Doppler measurements, worldwide and homogeneous distribution of ground beacons, tracking coverage, etc., 2. The provision of a very high number of doppler observations used in the derivation of JGM gravity fields. Many results in the domain of large scale ocean dynamics perfectly illustrate the benefit of DORIS as a T/P tracking system: first accurate quantification of seasonal signals, quantification of basin scale ocean signals and of ocean topography signals linked to El Nino/La Nina events, etc.

Besides direct benefit of DORIS for orbit computation, another benefit is more directly linked to geodesy. It has revealed extremely important in the field of mean sea-level trend determination. Comparison between estimates of sea-level rise from altimetry and in situ tide gauges has lead to a very careful analysis of how to use tide gauge data. As it is well known, in the frame of climate change studies, the variable of interest for different scenarios of global warming is absolute sea-level change. However, the problem with tide gauges is that they measure sea-level relative to a fixed crustal reference point. At many tide gauges, the long-term crustal rebound and tectonic uplift rates have amplitudes that are comparable to sea-level rise; then, without accurate crustal movement model, the resulting signals are inseparable. A clear requirement is thus that geocentric location of tide gauges using precise space geodetic techniques be directly monitored. Besides laser shots towards passive geodetic satellites, DORIS also brings a very accurate solution to this problem. And having altimeter and tide gauge data in a common and well maintained geodetic reference frame where DORIS brings a significant contribution is of course very important. Last, when one talks about reference frame, the issue of the position of the center of mass of the Solid Earth/Ocean/Atmosphere system is raised. And, because the center of mass is defined as the reference frame origin for the altimeter measurements of sea-level, then center of mass variations must be properly accounted for in the realization of the tracking station locations within this frame. Even if geocenter variations, as determined using DORIS data, are of the order of 10 mm in each coordinate, secular trends in the geocenter components may be carefully surveyed for long-term measurements of sea-level change.

Other benefits from the DORIS system may be displayed still in the altimeter framework: * derivation of estimates of total electronic contents, * use of the new and very accurate real time navigation capability that will inaugurate a new era in operational altimetry.

Jason-1 and ENVISAT will embark DORIS: This fully confirms DORIS as a key element for the realization of the full potential of altimetry, both at operational and scientific time scales.

SESSION: LOCALISATION AND APPLICATIONS

DORIS Weekly Point Positioning at IGN: Present Status and Perspectives

Pascal Willis, Patrick Sillard, *Institut Géographique National, France*

Within the scope of the ITRS time series experiment, IGN has proposed to submit regularly weekly solutions including simultaneously weekly stations coordinates and daily earth rotation parameters. The goal of this paper is to present to current hypothesis used to derive such a DORIS series, to present preliminary results and to discuss possible future scientific uses for geodesy and geophysics. In particular, weekly station coordinates will be compared both internally and externally using other series available at IERS (e.g., VLBI, GPS, SLR). Current models used to derive the DORIS solutions will be presented. Finally, the combination of these weekly solutions to obtain a global solution (to be submitted for the ITRF2000 realization) will be discussed.

The ITRS Time Series Experiment: Presentation and Application to the IGN/DORIS Solution

Pascal Willis, Patrick Sillard, *Institut Géographique National, France*

The ITRS is now a well known and widely used terrestrial reference system. Usually, users access it through annual realizations called ITRF-XX including stations positions and velocities. However such a product does not entirely solve the problem of non-linear stations displacements and also does not totally make profit of terrestrial reference frames and polar motion series correlations. Within the IERS, a Pilot Experiment has been organized to specifically investigate these research aspects. A dedicated software has been developed at IGN to process SINEX files including simultaneously weekly stations coordinates and daily Earth rotation parameters derived by IERS techniques: VLBI, SLR, GPS and DORIS. The goal of this paper is to present this Pilot Experiment and the modeling used in this new software package. Finally a DORIS solution will be used in conjunction with GPS/IGS solutions to estimate the current level of accuracy obtained by the IGN/DORIS analysis group to determine the Earth rotation parameters.

DORIS Campaigns at Dome C, Antarctica in 1993 and 1999-2000.

C. Vincent, JJ. Valette, L. Soudarin, JF. Crétaux, B. Legresy, F. Rémy, A. Capra

Two geodetic DORIS campaigns have been implemented at Dome C by the LGGE/CNRS. The first campaign lasted from 25 November to 6 December 1993, the second lasted from 8 December 1999 to 4 January 2000. In 1993, DORIS gave accurate ITRF absolute coordinates of a reference point near the EPICA ice coring site. They were used to tie a GPS strain network. During the 1999-2000 campaign, two points were observed, the previous point and a new one simultaneously with two beacons. All data will be processed with the GINS/DYNAMO software at the LEGOS/GRGS with the most recent GRIM5 earth's gravity field.

Comparison of geodetic results over 6 years will give 3D absolute ice flow velocity at the drilling point. The summit of the Dome has been selected to be the coring site because the horizontal displacements are expected to be the lowest. In the opposite, the geochronological interpretation of the ice core data would become more complex. Estimation of the height variations is important to verify the balanced effects of ice flow and snow accumulation. However, the aim is very ambitious considering the only two determinations and the complexity of geodetic observations on ice. Carrying on DORIS measurements at Dome C every two years (at least?) appears to be of great interest. GPS monitoring has already been performed in 1993 and 1999 and will be repeated. Moreover, Dome C will become a space radar ice reference site. A DORIS contribution to calibrate ERS interferometry and altimetry is under investigation. A proposal for future campaigns has been proposed to the DORIS Pilot project. Past and future data will be delivered to IERS and accessible via IGN or CDDIS data base.

Vertical Motions Due to Global Redistribution of the Surface Load

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Temporal variations in the geographic distribution of the surface loads (atmosphere, ocean, soilmoisture and snow) deform the Earth's surface in particular in the vertical direction. This displacement can now be detected by space geodesy.

Using climatologic data we have computed vertical displacements associated with each kind of load. ECMWF pressure data, soil moisture from Huang et al. [1996] snow depth from ISLSCP and ocean load from POCM model have been used for that purpose.

We also computed the total crustal vertical displacement on a 2.5x2.5 degrees grid and focused on the annual cycle. Pressure contribution is mostly located over Asia, Greenland, Australia and Antarctic (up to 5 mm). Snow contribution is about 4 mm. and can reach 6 mm. in high latitude. Soil moisture contribution is essentially located in the tropics with a max annual amplitude of around 8.5 mm. Finally, the ocean contribution has a more modest amplitude, up to 1.5 mm and concern the Indian ocean, Pacific ocean, and around the Antarctic. Annual variations in the vertical coordinates of the Doris network station have been reported. Here we compare these spaced geodesy-derived annual vertical motions with that predicted from climatology data. A very good correlation is noted in many stations.

SESSION: AUTONOMOUS NAVIGATION

SESSION: INTERNAL DORIS SERVICE

DORIS Contribution to the Determination of Polar Motion

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Abstract: DORIS was included in the IERS as the fifth geodetic technique in 1995. In the last year, the Satellite and Lunar Laser Ranging (SLR/LLR) on one hand and VLBI on the other hand were organized into international Services (respectively IVS and ILRS) following the IGS Service created in 1993. The possibility of an International DORIS Service (IDS) was discussed during the IERS Directing Board meeting held in Potsdam in September 1998. A Technique Center for DORIS is currently being organized as a Pilot Experiment within Commission VIII (CSTG) of the International Association of Geodesy. Although the Earth orientation monitoring is not its primary objective, DORIS can bring information on polar motion. Since Spring 1999, the CLS section in Toulouse is sending on an operational basis to the Central Bureau of the IERS in Paris the pole components derived from the analyses of the observations of 3 satellites (TOPEX, SPOT2, SPOT4). Different solutions are produced over data intervals of respectively 24 hours, 30 hours and 3 days. The accuracy of DORIS solutions is in the range of 1-1.5 mas corresponding to 3-5 cm on the Earth surface. These pole component estimates can be useful for near-real time estimations as well as an external check for orbital analysis. It is assumed that a better accuracy will be reached after the launches of the ENVISAT, JASON and SPOT5 spacecraft.

Current Status of the DORIS Pilot Experiment

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DORIS is one of the four techniques contributing to the International Earth Rotation Service. The other techniques have an international service providing the scientific community with data and products. There is an increasing demand among the international scientific community for a similar DORIS Service. The CSTG and IERS Directing Boards decided in July (IUGG99 in Birmingham, UK) to initiate a DORIS Pilot Experiment. The aim of the Experiment is to assess the need and feasibility of an International DORIS Service, attaching a particular care to its international character and the long-term involvement of contributing organizations. A Call for Proposals was broadcasted in September to prompt qualified organizations to submit proposals for components of the future IDS. We received proposals for the Central Bureau, Data Centers, Analysis Centers, existing satellites and new stations. The joint CSTG/IERS DORIS Pilot Experiment Terms of Reference were presented and discussed at the CSTG Executive Committee Meeting held during the AGU Fall Meeting (San Francisco in December 1999). This paper recalls the objectives of the future IDS, points out its components and structure, describes the organization of the Experiment and draws up a report of the preliminary activities related to it.

Global Geodesy from SPOT-2 DORIS

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The recognition that the DORIS technique on the SPOT satellites, although primarily for the orbit determination of these remote sensing satellites, can be successfully exploited to provide high precision geodetic products, Earth Orientation Parameters (EOP) and a set of globally distributed station coordinates. One year of SPOT-2 DORIS data has been processed for precise orbit determination, EOP and station coordinates. These solutions are compared to the combined Lageos-1 and Lageos-2 SLR solutions for the same period, Bulletin B EOP, and the ITRF97 set of station coordinates. A limited combined solution with SPOT-4 is also undertaken. The data, computation procedure and results are presented and discussed demonstrating the capability of DORIS to contribute to the densification of the ITRF in remote regions of the world.

SESSION: SYSTEM AND PERFORMANCE EVOLUTIONS

SESSION: FUTURE DIRECTIONS

The Relationship between Global Vertical Crustal Movement and Geoidal Height

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1. Introduction. Recently, observation results by DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite) ranging from 4 to 5 years were reported (Cretaux et al., 1998; Soudarin et al., 1999). In major primary factors of global crustal vertical movement, the Post postglacial rebound (PGR) is well known. However, the results of DORIS are not in harmony with a prediction model except for some high-latitude observation points near ice sheets (Soudarin et al., 1999). Does crustal vertical movement by an unknown factor mechanism exist? In this draft, we state an idea of qualitative interpretation about the result of DORIS.

2. The relationship between vertical velocity and geoidal height. Figure 1 (<http://www.tries.gr.jp/~tanaka/fig1.gif>) shows the relationship between vertical velocity of "stable" observation points by Soudarin et al. (1999) and the geoidal heights model of "EGM96" model (below degree and order 7). Here, the classification of "stable" follows Cretaux et al. (1998). The correlation between geoidal depression and crustal uplifting in the area from North America to South America is characteristically obvious. Figure 2 (<http://www.tries.gr.jp/~tanaka/fig2.gif>) is the graph made of Figure 1. This figure also includes velocities at "Plate-Fixed Stations" of VLBI (Heki, 1996), too. Though the VLBI's velocities indicate violent fluctuation relatively, both techniques show good agreement. For the DORIS, there is a maximum at 40m in of geoidal height and a minimum at -20m of it. Moreover, there is a center of symmetry at +15m of geoidal height. The rough pattern is invariable, even though PGR predictions are taken into account.

3. A proposal of interpretation. We suggest the pattern of figure2 reflect plume activity and potential energy release of the earth (Figure 3; <http://www.tries.gr.jp/~tanaka/fig3.gif>). The area higher than 50m of geoidal height uplifts by positive buoyancy (cf. around the Azores islands, Indonesia). The area ranging from +50 ~ +15m of geoidal height correspond to positive PE release zone. Therefore, the higher geoidal height gets, the more rapid crustal subsidence become. The area ranging from +15 ~ -20m of geoidal height correspond to negative PE release zone, so crustal uplifting occur. Thus, in the geoidal height from +50 to -20m, authors imagine viscous liquid (or mantle material) becomes flat. Additionally, a linear relationship between geoidal height and PE exists under the isostatic compensation (Turcotte and Schubert, 1982). Finally, the areas lower than -20m of geoidal height subsides by negative buoyancy because of cold plume.

4. Problems and future prospect. Can we regard low order geoidal height higher than +60m and lower than -40m as plume heads? Numerical simulations point out the relationship between convective flow and geoid depends on the condition of density discontinuity and coefficient of viscosity. Furthermore, income and expenditure of total mass due to uplift and subsidence must be zero (if not, the earth comes to be expanded or contracted). Past researches about the relationship between PGR and viscous structure of mantle have been discussed the earth's response based

on crustal uplifting from sea level and stratified viscosity model. The results of global seismic tomography recently emphasize lateral inhomogeneities, so it is the problem about PGR to be considered. Anyway, further observations and theoretical studies are expected to clear the vertical velocity of the DORIS.

Reference:

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Soudarin et al. (1999): Geophys. Res. Lett., 26, 1207-1210.
Cazenave et al. (1999): Geophys. Res. Lett., 26, 2077-2080.
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Turcotte and Schubert (1982): Geodynamics, John Wiley, 450p.

The NEtlander Ionosphere and Geodesy Experiment

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The objective of the NEtlander Ionosphere and Geodesy Experiment (NEIGE) of the Netlander Mission to Mars is, on the first hand, to determine Mars orientation parameters in order to obtain information about the interior of Mars, about the seasonal mass exchange between atmosphere and ice caps, and, on the second hand, to determine the total electron content (TEC) and scintillation parameters of the Mars ionosphere. This double information will be derived from measurements of the characteristics (amplitudes and Doppler shifts) of the radio links between a set of landers and an orbiter and between this orbiter and the Earth.

A two-way coherent link at UHF-band between the landers and the orbiter, as well as a coherent uplink lander-orbiter at S-band will be used. Both links require a stability of the reference frequency on board the orbiter of 10E-11 for an averaging time of 20 seconds (Doppler counting integration time). The Doppler shifts will be measured on board the orbiter with an accuracy of 0.1mm/second. The TEC can be deduced from phase measurements on the propagation paths between the landers and the orbiter. An appropriate combination of the measurements at the two UHF and S-Band frequencies will allow the determination of the TEC and will provide corrected measurements for geodesy. The orbiter motion will be modeled, with respect to the Earth, by using its Doppler tracking at X-band.

From the modeling of the relative speeds of the orbiter/Netlanders and orbiter/Earth it will be possible to obtain the Mars orientation parameters, namely Mars rotation, polar motion and nutations.

From the nutation data, physical parameters of Mars' interior can be obtained. In particular we will be able to answer the question whether the core is liquid or solid. This is due to the fact that, if the core is liquid, the Free Core Nutation (FCN) normal mode will create a resonance effect in the nutations. The FCN, which only exists when the core is fluid, is related to the possibility of having a core rotating around an axis different from the rotation axis of its ellipsoidal deformable container (the mantle). The observational signature of such a resonance would indicate that the core is liquid. The resonance effects depend on the resonance frequency and resonance strength, which, in turn, depend on the moments of inertia of the core and of the whole planet, on the global flattening and the core flattening, on the core dimension, on the density profile, on the elastic (or inelastic) parameters, on the departure from hydrostatic equilibrium and on the existence of an inner core.

The transfer of angular momentum between the atmosphere and the planet induces variations in length-of-day, polar motion and nutations. The main cause of these variations is the seasonal mass exchange between the atmosphere and the ice caps, associated with the CO₂ condensation/sublimation process. With the expected precision of NEIGE the induced variations in length-of-day and polar motion will be observable and an estimate of the seasonal mass exchange can be derived.

From the uncorrected raw Doppler shifts it is also possible to obtain the TEC, its spatial repartition and time variations. This parameter is useful to understand the structure of the ionosphere, and in particular, its horizontal gradients. These will reveal the transport of plasma from the dayside to the nightside ionosphere. On the nightside they will allow to study plasma holes which are expected to be places of plasma escape towards the interplanetary medium. It will also allow observation of the Travelling Ionospheric Disturbances and scintillation effects. High resolution amplitude and phase measurements will allow to study scintillation of the radio signals on both radio links, thus giving access to a characterization of small scale ionospheric irregularities which are driven by the interaction of the ionosphere either with the solar wind or with the atmosphere. The study of the ionosphere by the

NEIGE experiment will support and benefit of the GPR and MAG experiments. All together, these three experiments will allow a detailed study of the bottomside ionosphere and of electrodynamics of the ionized environment of Mars.extend

From the Doppler shift data, and as it is summarized in the following Figure, it will thus be possible to answer questions not yet resolved concerning the ionosphere, the ice cap and atmospheric seasonal mass exchange and the interior of the planet. It will provide unique information that can be reached neither with the past data, nor with any other present experiment. NEIGE will additionally be in synergy with the meteorological experiment (ATMIS) and the seismic experiment (SEIS) of Netlander.

SESSION: OTHER

Current Status and Evolution Prospects of the DORIS Network

H. Fagard, *IGN/SGN, France*

The deployment of the ground network of permanent orbit determination stations, one of the essential components of the DORIS system, has been going on for more than ten years, starting before the launch of the first satellite carrying a DORIS receiver. At the moment, this network has 54 homogeneously distributed stations, among which more than thirty are co-located with other space geodesy techniques (VLBI, SLR, or GPS) which contribute with DORIS to the realization of the international terrestrial reference system. After a presentation of the current status of the network beacons, antennas and maintenance statistics, we give a general survey of the quality of the monumentation and the stability of the reference point of the antennas, for which an improvement action has been taken in order to make them compatible with the current accuracy of the DORIS positioning results. The features and the deployment plans of the third generation beacons, currently under development, are presented. The purpose of the network's future evolutions will be twofold: improve the geodetic quality of the existing stations, and fill the few remaining gaps in the global coverage.

Interaction Between Scientific Research and Services

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In the last decade, the wide spread use of space techniques in all fields of geodesy and the development of powerful and easy-to-use communication means have allowed a spectacular transformation of the traditional services activities into privileged forums for scientific discussions, in a spirit of friendly but alert competition. The analysis of the organization and operation of some of these new generation scientific services may carry useful information when preparing for a new international service.

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SESSION: ORBIT DETERMINATION

SESSION: LOCALISATION AND APPLICATIONS

Quality Assessment of Recent DORIS Terrestrial Reference Frame Solutions

Zuheir Altamimi, Claude Boucher, *Institut Géographique National, France*

Starting with ITRF94, DORIS Analysis Centers continue to contribute to the International Terrestrial Reference Frame (ITRF), providing station positions and velocities of the DORIS network.

Quality of the submitted DORIS TRF solutions is regularly evaluated by the IERS TRF section. In this paper we intend to investigate more recent DORIS solutions and in particular those submitted to the ITRF2000 standard solution. Analysis will be performed both on TRF definition as well as quality assessment.

A Revised DTM Atmospheric Density Model: Modeling Strategy and Results

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Empirical atmospheric density models are used in satellite orbit determination in the computation of the atmospheric drag force, besides their obvious use in atmosphere studies. They represent temperature and density as a function of altitude, latitude, local solar time, day of year, and parameters related to the state of atmospheric heating. The MgII index has been used to describe solar chromospheric activity, and Km that of the geomagnetic activity.

A new DTM-type model has been elaborated, in which the description at the lower limit (120 km) is now in accordance with the expected variations in the lower thermosphere. The lower limit modeling is based on incoherent scatter radar and WINDII (aboard the satellite UARS) observations. The problem we encountered is that there is only one large density dataset concurrent with MgII observations, namely that of the Dynamics Explorer 2 (DE-2) mass spectrometers. These data are only under high solar activity conditions and cover 1_ years. To overcome this too short time span, and the absence of data during low solar activity, satellite drag total density data has been obtained using precise orbit computations of SPOT-2 (1993-1999), Starlette (1990-1999), and Stella (1994-1999).

These data, combined with the DE-2 spectrometer data, have then been used in the modeling of the atmosphere in the altitude range of 225 to 1000 km.

DORIS Data Analysis at the Institute of Astronomy, RAS

S.K. Tatevian, S.P. Kuzin, *Institute of Astronomy, RAS (INASAN), Russia*

From the beginning of the DORIS mission on SPOT2 in accordance with the bilateral agreement with CNES/IGN the INASAN took an active part in installation and maintenance of permanent DORIS beacons in Russia and CIS territory. Now in the frame of the Pilot Project on "International DORIS Service" analysis of DORIS data is carried on with the use of GIPSY-OASIS II software (received under license from the JPL/CALTECH) in free-network multi-satellites approach (SPOT2+SPOT4+TOPEX/Poseidon). The DORIS modules, worked out at the IGN/LAREG was ported on SUN SPARC workstation running Solaris 2.5.1. This poster describes data processing procedure, weekly station positions obtained for several months of 1999 and summary of data analysis.

DORIS Accurate Location Service : 1- from Request to Delivery and 2- the Applications

J.J. Valette, B. Nhun Fat, M.N. Loaec. *CLS, Collecte Localisation Satellites, France*

CLS, the CNES subsidiary dedicated to satellite-based location and data collection, provides DORIS accurate location service. The coordinates are calculated by the DORIS/POSEIDON Processing Center (DPPC) using measurements received from the SPOT satellites. This poster describes system operations from the user's request to the delivery of the results. It also shows examples of applications in the field of geodesy, geophysics and geotechnics.

One Day Operation of the DORIS System Ground Segment

M.N. Loaec, B. Nhun Fat, J.J. Valette, *CLS, Collecte Localisation Satellites, Ramonville, France*

This poster describes all the components of the DORIS system ground segment :

- the DORIS instruments control and processing center,
- the telemetry receiving stations,
- the satellites control centers,
- the master beacons,
- the permanent beacon network,
- the location customers beacon network,
- the IGN beacon installation and maintenance unit,
- the DORIS orbit determination department at CNES,
- other external interfaces.

Demonstrations of the data processing, the satellite orbit and beacon positioning determinations will be also available on a screen monitor.

SESSION: AUTONOMOUS NAVIGATION

SESSION: INTERNAL DORIS SERVICE

The DORIS Data Center at the CDDIS

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The Crustal Dynamics Data Information System (CDDIS) serves as a global data center for the DORIS Pilot Experiment providing a data archive and distribution service to the experiment. The CDDIS has archived DORIS data since the launch of the TOPEX/Poseidon mission in 1992. Since that time, the CDDIS has archived DORIS data from the SPOT-2, -3, and -4 missions. This paper will present information about the archive and data holdings. More general information about the CDDIS and its support of other international space geodesy services (the IGS, ILRS, and IVS) will also be discussed.

Participation of LEGOS-GRGS and CLS as an Analysis Center in the future IDS

L. Soudarin, J.J. Valette, *CLS, Collecte Localisation Satellites, France*, J.F. Crétaux, A. Cazenave, *LEGOS-GRGS, France*

LEGOS-GRGS and CLS have been involved in DORIS data processing since the launch of Spot-2 in 1990, the first satellite with DORIS onboard. LEGOS-GRGS and CLS are in charge of the scientific analysis of DORIS data in the field of geodesy, geophysics and space oceanography. LEGOS-GRGS being a DORIS Analysis Center for IERS since 1994, will naturally carry on this activity in the frame of the Pilot Project on "International DORIS Service" with the support of CLS which has a strong experience as a system operator. This paper will present the data processing procedure and the products generated with the GINS/DYNAMO software.

SESSION: SYSTEM AND PERFORMANCE EVOLUTIONS

SESSION: FUTURE DIRECTIONS

SESSION: OTHER